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(54) Improved centrifugal pump.

(57) Improved centrifugal pump of the type comprising a supporting body (10) for a permanent-magnet synchronous motor with an impeller (49) coupled to its rotor (22), and for a volute (48) in which the impeller is accommodated. The body (10) and the volute (48) form a sealed housing which contains the rotor and the impeller in respective chambers, separating them from the stator part of the motor. The rotor (22) is rigidly coupled to a shaft (24) that rotates on sliding bearings (26,29) supported by elastic supports (27) which are locked in the corresponding chamber; one of these supports forms a ring for providing hydraulic sealing between the two chambers of the container.

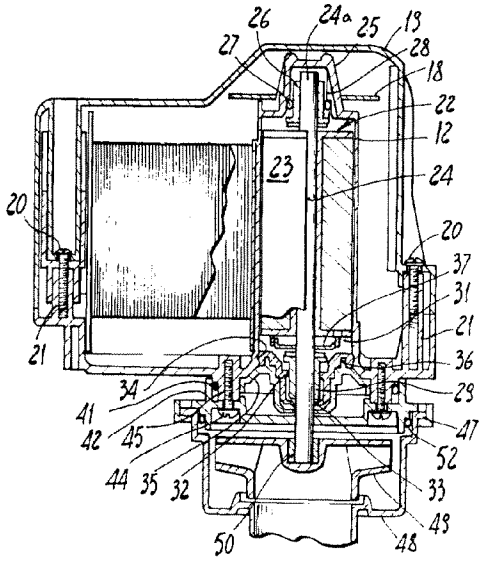

FIG. 2

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The present invention relates to an improved centrifugal pump.

The pump can be used, particularly but not exclusively, as a pump for dishwashers, as a pump for other household appliances, as a circulating pump for heating systems, etc.

Known pumps suitable for these uses are coupled to asynchronous electric motors and consequently entail some problems particularly due to the fact that the rotor parts are air-immersed.

This leads to a certain noisiness and to the need to adequately lubricate the supports and the rotation bearings to avoid their early wear.

Centrifugal pumps with an asynchronous permanent-magnet motor, in which the rotor part is contained in a sealed housing separating it from the stator part and containing a lubricating liquid, are also known.

However, these pumps have proved to be unsuitable for the particular use requiring rather large flow-rates and heads which they cannot achieve since the motor, by being able to start indifferently in one rotation direction or the other, entails the use of unsophisticated and low-efficiency hydraulics.

The aim of the present invention is to eliminate the drawbacks mentioned above in pumps with asynchronous motor.

A consequent primary object of the present invention is to prevent the onset of noise, vibrations or early wear due to insufficient lubrication.

Another important object is to prevent the start-up problems occurring in current pumps with air-immersed rotor due to the mutual sticking of the parts when not in use.

With this aim in view, as well as these and other objects which will become apparent hereinafter, there is provided, according to the present invention, an improved centrifugal pump of the type comprising a supporting body for a permanent-magnet synchronous motor with an impeller coupled to its rotor, and for a volute in which said impeller is accommodated, said body and said volute forming a sealed housing which contains the rotor and the impeller in respective chambers, separating them from the stator part of said motor, said pump being characterized in that said rotor is rigidly coupled to a shaft that rotates on sliding bearings supported by elastic supports which are locked in the corresponding chamber, one of said supports defining a ring for providing hydraulic sealing between the two chambers of said housing.

Further characteristics and advantages of the centrifugal pump according to the present invention will become apparent from the following detailed description of a preferred but not exclusive embodiment thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figures 1 and 2 are sectional views of the centrifugal pump according to the present invention, taken along mutually perpendicular planes passing through the axis of the motor;

figure 3 is an exploded perspective view of the pump;

figure 4 is a partially exploded sectional view of the pump.

With reference to the above figures, a centrifugal pump comprises a supporting body 10 made of plastic material composed of a base 11, from which an element 12, shaped like an inverted cup and open at said base 11, extends at right angles.

The element 12 is externally partially surrounded by the poles formed by a pack of metal laminations 13 which, together with windings 14, forms the stator part of the pump motor.

The lamination pack 13 is fixed laterally by means of brackets 15 to the base 11 of the body 10.

Fixing occurs by means of self-tapping screws 16 that pass in through holes of the brackets 15 and engage tubular tabs 17 of the base 11.

An electronic board 18, of the kind disclosed in EPA N. 93109284.5 filed June 9, 1993 by the same Applicant and suitable to achieve the unidirectional rotation of the rotor of a permanent-magnet synchronous motor, is furthermore located on the top of the cup-like element 12.

A box-like housing 19 made of plastics covers the entire stator part of the motor and is fixed to the base 11 by means of self-tapping screws 20 that pass in through holes of the housing and engage tubular tabs 21 of said base 11.

A permanent-magnet rotor 22 is located inside the element 12 and is thus separated from the stator part; said rotor is embedded in a jacket 23 made of diamagnetic material, for example stainless steel, which accordingly does not affect the operation of the motor.

The rotor 22 is rigidly coupled to a shaft 24 passing axially therethrough and a first end 24a whereof is located inside a tapered top portion 25 of the element 12.

Said end 24a is rotatable on a sliding bearing 26 having a cylindrical bush and an annular flange on the side of the rotor 22; said bearing is supported by an elastic support constituted by an elastomer ring 27, for example of the O-ring type, which is interposed between said bearing and the wall of the tapered portion 25 in which a corresponding seat is formed.

A radial groove 28 is formed on said wall and connects the two internal parts of the tapered portion 25 which are divided by the ring 27.

On the other side there is also a sliding bearing 29 for the second end 24b of the shaft 24; said

bearing 29 is identical to the bearing 26, but the elastic support that now supports it is integrated in an elastomer cap 30 that closes the chamber 31 of the rotor 22.

In particular, said cap 30 has an internal annular ridge 32 for supporting the bearing 29, an internal annular end lip 33 for forming a sliding seal on the shaft 24, and an annular outer ridge 34 for providing a seal on the inner wall of the cup-like element 12.

Said cap 30 is supported by a lid 35 made of plastics which is shaped substantially complementarily thereto and rests between the base 11 and the cup-like element 12 at the open end of the latter.

The portion of the cap 30 that comprises the ridge 34 is located between an annular ridge 36 of the lid 35 and the internal wall of the element 12.

It should also be noted that a washer 37, suitable to prevent wear of the bearing 29, is fixed to the end of the rotor 22 on the side of said cap 30.

An annular ridge 38 extends around the lid 35 on said base 11 and forms externally a seat 40 for an elastomer ring 41, for example of the O-ring type, for forming a seal between said ridge 38 and a corresponding ridge 42 of a disk-like intermediate impeller-supporting element 43 which is also made of plastics.

The element 43 is fixed to the base 11 by means of self-tapping screws 44 that pass in through holes thereof and engage tubular tabs 45 of said base 11 located internally with respect to the ring 41.

The intermediate element 43 has an axial hole allowing the shaft 24 to protrude and has radial spokes 46 resting on the lid 35, locking it between said lid and its corresponding seat.

A volute 48 is fixed by means of bayonet couplings 47 on the intermediate element 43 and contains an impeller 49.

Said impeller is rigidly coupled to the end 24a of the shaft 24 and is inserted and locked in a tubular insert 50 which is accommodated in an adapted seat 51.

A hydraulic sealing ring 52, for example of the O-ring type, is provided between the intermediate element 43 and the volute 48 and is appropriately located between corresponding edges thereof.

First of all it should be noted that the permanent-magnet synchronous motor becomes unidirectional due to the presence of the electronic board.

This has allowed to provide the volute 48 with an axial intake and a tangential delivery and an impeller 49 with curved vanes.

As mentioned, the part of the pump that contains the rotor 22 in one chamber and the impeller 49 in another chamber is fully separated and sealed from the rest.

The rotor 22 is immersed in a liquid bath, and this considerably reduces noise and vibrations as well as wear of the sliding bearings.

Lubrication is independent, and this avoids the mutual sticking of the parts during idle periods and consequent start-up problems.

Finally, the presence of the intermediate element 43 allows to interchange the hydraulic part with respect to the electrical part.

In practice it has been observed that the intended aim and objects of the present invention have been achieved.

The invention thus conceived is susceptible to numerous modifications and variations, all of which are within the scope of the inventive concept.

All the details may furthermore be replaced with other technically equivalent elements.

In practice, the materials employed, so long as they are compatible with the contingent use, as well as the dimensions, may be any according to the requirements.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Improved centrifugal pump of the type comprising a supporting body (10) for a permanent-magnet synchronous motor with an impeller (49) coupled to its rotor (22), and for a volute (48) in which said impeller (49) is accommodated, said body (10) and said volute (48) forming a sealed housing which contains the rotor and the impeller (49) in respective chambers, separating them from the stator part (13,14) of said motor, said pump being characterized in that said rotor (22) is rigidly coupled to a shaft (24) that rotates on sliding bearings (26,29) supported by elastic supports (27,30) which are locked in the corresponding chamber (31), one of said supports forming a ring for providing hydraulic sealing between the two chambers of said housing.

2. Centrifugal pump according to claim 1, characterized in that said permanent-magnet rotor is embedded in a jacket (23) made of diamagnetic material.

3. Centrifugal pump according to one or more of the preceding claims, characterized in that the

stator part (13,14) of said motor comprises, in addition to a pack of laminations (13) that form the poles and electrical windings (14), an electronic board (18) adapted to make said motor unidirectional at start-up.

4. Centrifugal pump according to one or more of the preceding claims, characterized in that an intermediate element (43) is interposed between said supporting body (10) and said volute (48) and is adapted to allow the interchangeability of the hydraulic part with respect to the electric part.

5. Centrifugal pump according to one or more of the preceding claims, characterized in that said rotor (22) is immersed in a liquid bath.

6. Centrifugal pump according to one or more of the preceding claims, characterized in that said supporting body (10) comprises a base (11) from which a cup-shaped element (12) extends at right angles, said cup-shaped element (12) having an opening located at said base (11), said cup-shaped element (12) being externally partially surrounded by the poles formed by said pack of laminations (13).

7. Centrifugal pump according to one or more of the preceding claims, characterized in that said electronic board (18) is located on the outer top of said cup-shaped element (12).

8. Centrifugal pump according to one or more of the preceding claims, characterized in that a first one (26) of said sliding bearings is located at a tapering top portion (25) of said cup-shaped element (12), said bearing (26) being supported by an elastic support constituted by an elastomer ring (27) that is interposed between said bearing (26) and the wall of said tapering portion (25) in which a corresponding seat is formed, a radial groove (28) being formed on said wall and being adapted to connect the two inner parts of said tapering portion, which are divided by said elastomer ring (27).

9. Centrifugal pump according to one or more of the preceding claims, characterized in that a second one (29) of said sliding bearings is supported by an elastic support which is integrated in an elastomer cap (30) closing the chamber (31) of said rotor, said cap (30) having an internal annular ridge (32) for supporting said bearing (29), an internal end lip (33) for forming a sliding seal on said shaft (24), and an annular external ridge (34) for forming a seal on the inner wall of said cup-shaped element (12).

10. Centrifugal pump according to claim 9, characterized in that said cap (30) is supported by a lid (35) which is substantially shaped complementarily thereto and rests between said base (11) of said supporting body (10) and said cup-shaped element (12) at the open end thereof, the portion of said cap (12) that comprises said outer sealing annular ridge (34) being arranged between an annular ridge (32) of said lid (35) and the inner wall of said cup-shaped element (12).

11. Centrifugal pump according to one or more of the preceding claims, characterized in that a washer (37) is fixed to the end of said rotor (22) on the side of said cap and is suitable to avoid wear of the corresponding sliding bearing (29).

12. Centrifugal pump according to one or more of the preceding claims, characterized in that an annular ridge (38) is formed around said lid (35) on said base (11) of said supporting body (10) and forms externally a seat (40) with a ring (41) for forming a seal between said ridge (38) and a corresponding ridge (42) of said intermediate element (43).

13. Centrifugal pump according to one or more of the preceding claims, characterized in that said intermediate element (43) is fixed to said base (11) of said supporting body (10) by means of screws (44) located internally with respect to said sealing ring (41).

14. Centrifugal pump according to one or more of the preceding claims, characterized in that said intermediate element (43) has spokes (46) which are suitable to rest on said lid (35) of said cup-like element (12), locking it between said lid (35) and its corresponding seat.

15. Centrifugal pump according to one or more of the preceding claims, characterized in that said volute (48) is fixed on said intermediate element (43) by means of bayonet couplings (47), a hydraulic sealing ring (52) being provided between said couplings.

16. Centrifugal pump according to one or more of the preceding claims, characterized in that one end of said shaft (24) passes through said cap (30), said lid (35) and said intermediate element (43), ends in said volute (48) and is coupled to an impeller (49), the coupling being

obtained by inserting said end in a tubular insert (50) which is accommodated in an adapted seat of the impeller (51).

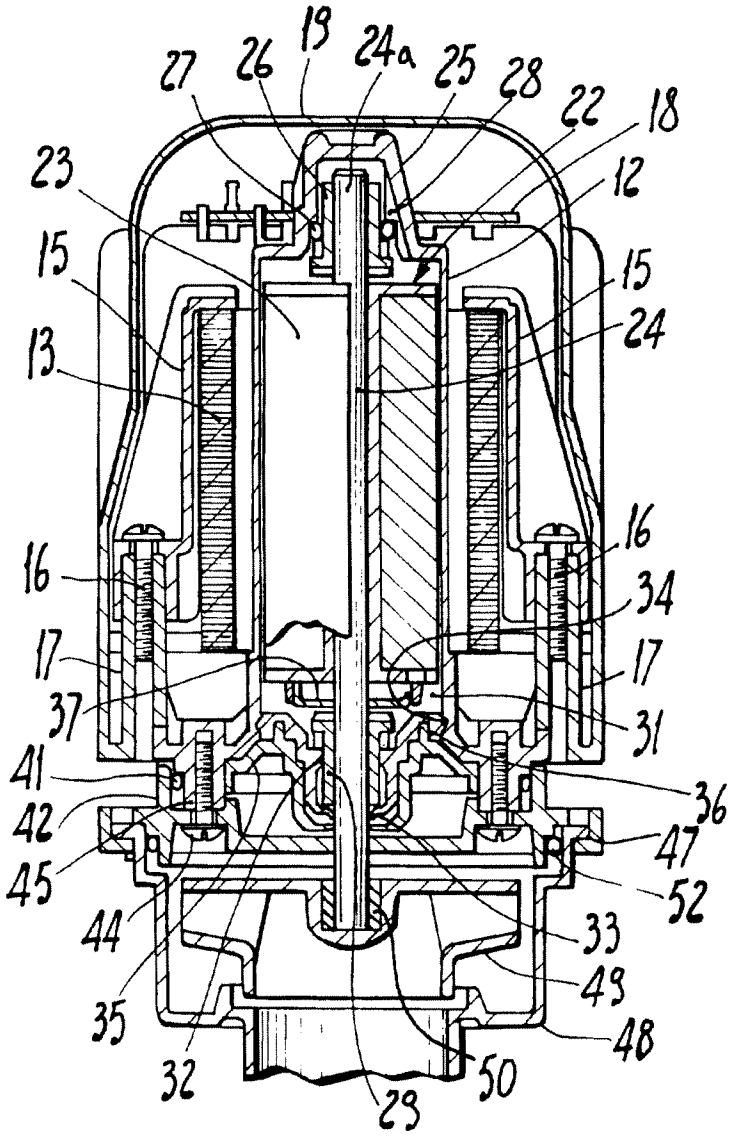
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FIG. 1

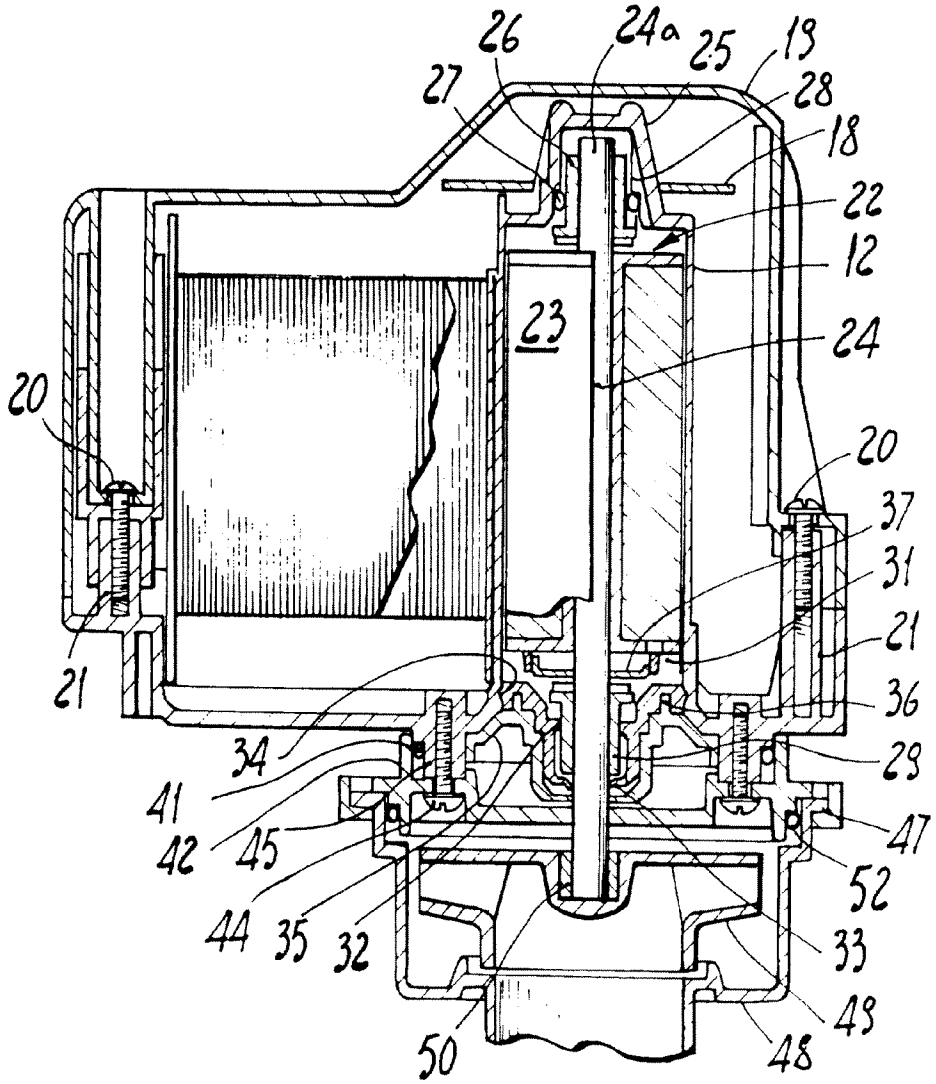
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FIG. 2

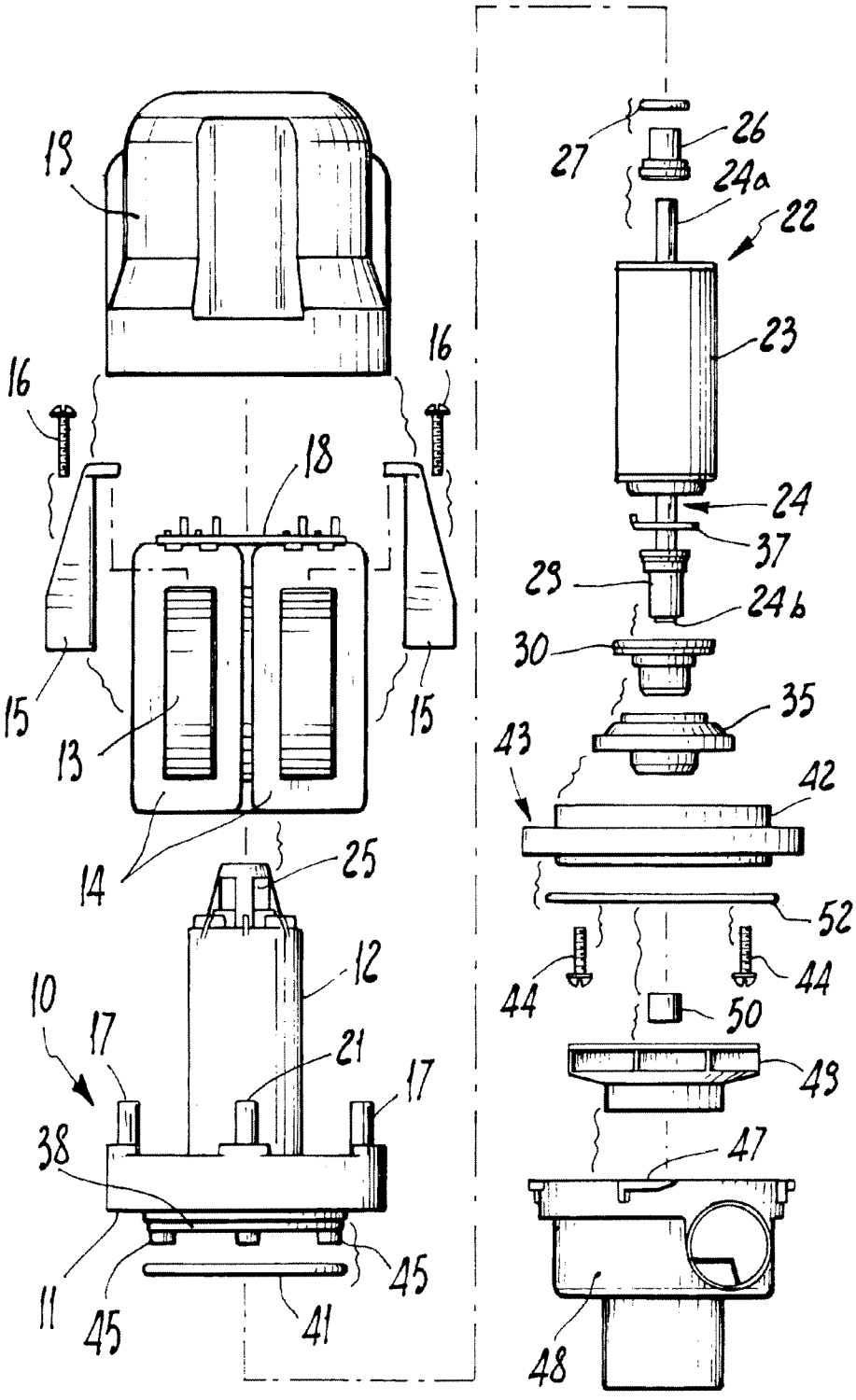
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FIG. 3

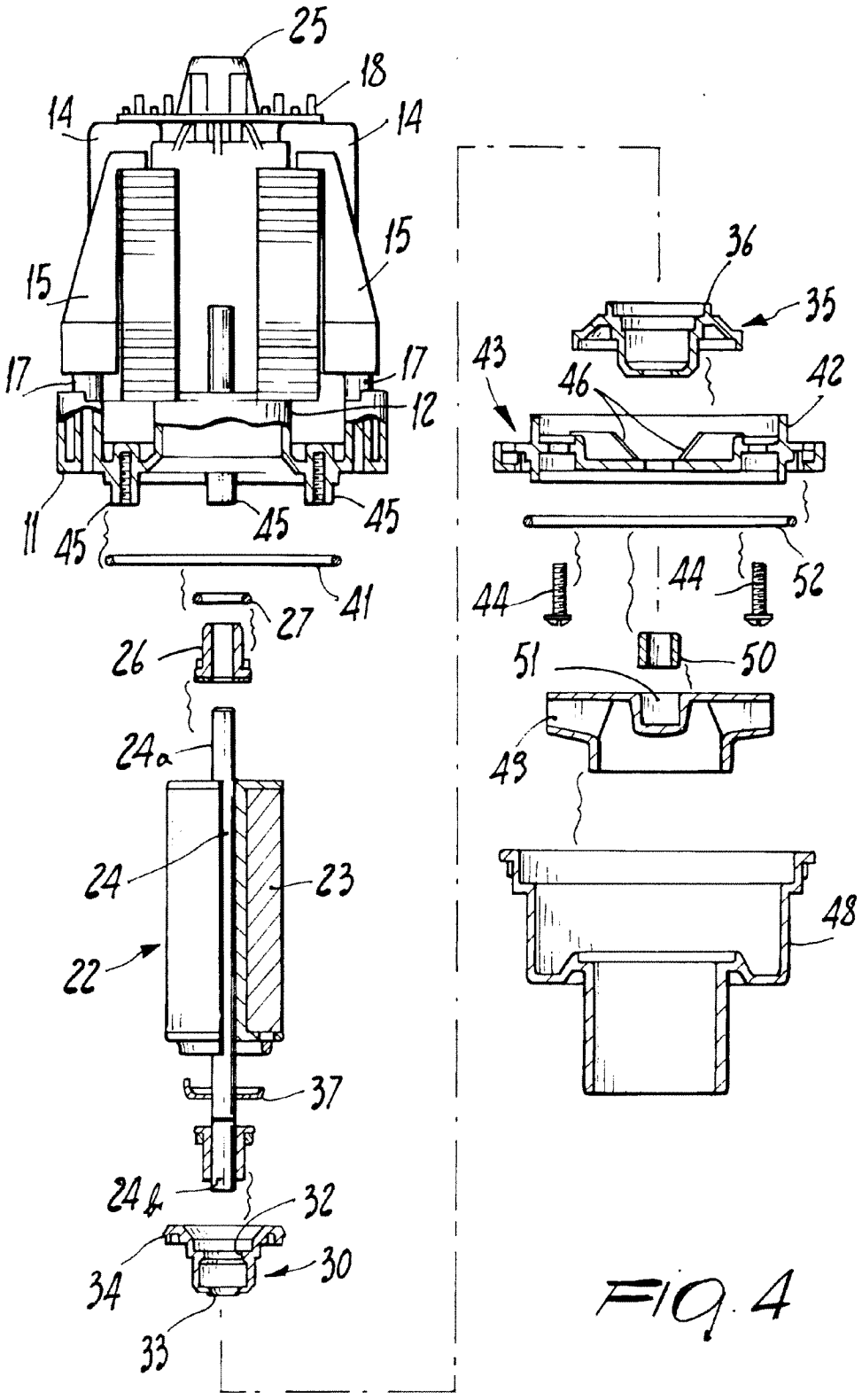
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FIG. 4